

effect. It is a question of the *degree* of condensation and rarefaction. In short, an explosion produces in the air waves of compression and rarefaction which are perceived by the ear as sound, and also can be seen by unequal refraction, if they are sufficiently strong." These phenomena are seen as concentric circles about the point where the explosion occurs; generally, the top of a volcano.—*C. L. M.*

PROPAGATION OF SOUND AND LIGHT IN AN IRREGULAR ATMOSPHERE.

[Reprinted from *Nature*, London, June 13, 1918, p. 284.]

I suppose that most of those who have listened to (single-engined) aeroplanes in flight must have noticed the highly uneven character of the sound, even at moderate distances. It would seem that the changes are to be attributed to atmospheric irregularities affecting the propagation rather than to variable emission. This may require confirmation; but, in any case, a comparison of what is to be expected in the analogous propagation of light and sound has a certain interest.

One point of difference should first be noticed. The velocity of propagation of sound through air varies indeed with temperature, but is independent of pressure (or density), while that of light depends upon pressure as well as upon temperature. In the atmosphere there is a variation of pressure with elevation, but this is scarcely material for our present purpose. And the kind of irregular local variations which can easily occur in temperature are excluded in respect of pressure by the mechanical conditions, at least in the absence of strong winds, not here regarded. The question is thus reduced to refractions consequent upon temperature variations.

The velocity of sound is as the square root of the absolute temperature. Accordingly for 1° C. difference of temperature the refractivity ($\mu - 1$) is 0.00183. In the case of light the corresponding value of ($\mu - 1$) is 0.000294×0.00366 , the pressure being atmospheric. The effect of temperature upon sound is thus about 2,000 times greater than upon light. If we suppose the system of temperature differences to be altered in this proportion, the course of rays of light and of sound will be the same.

When we consider mirage, and the twinkling of stars, and of terrestrial lights at no very great distances, we recognize how heterogeneous the atmosphere must often be for the propagation of sound, and we need no longer be surprised at the variations of intensity with which uniformly emitted sounds are received at moderate distances from their source.

It is true, of course, that the question is not exhausted by a consideration of rays, and that we must remember the immense disproportion of wave lengths, greatly affecting all phenomena of diffraction. A twinkling star, as seen with the naked eye, may disappear momentarily, which means that then little or no light from it falls upon the eye. When a telescope is employed the twinkling is very much reduced, showing that the effects are entirely different at points so near together as the parts of an object glass. In the case of sound, such sensitiveness to position is not to be expected, and the reproduction of similar phenomena would require the linear scale of the atmospheric irregularities to be very much enlarged.—*Lord Rayleigh.*

PROPAGATION OF SOUND IN AN IRREGULAR ATMOSPHERE.

By G. W. STEWART.

[Paragraph and synopsis reprinted from *The Physical Review*, vol. 14, No. 4, pp. 376-378. Article is reprinted in *Aeronautics*, Nov. 20, 1919, p. 467.]

Lord Rayleigh's recent reference¹ to and explanation of the "highly uneven character of the sound" from aeroplanes leads the writer to make a record of three additional facts.

Under poor atmospheric conditions, lower frequencies in aeroplane engine sounds become relatively enhanced; under good conditions frequencies of order of 1,000 d. v. are heard at greatest distances. The former is explained by irregularities in the atmosphere and the latter by characteristics of audition.

Intensity of the sound varies much more rapidly than as the inverse square, crude observations giving much more nearly inverse sixth and fourth powers for maximum ranges under fair and good listening conditions, respectively.

SOME UNSOLVED PROBLEMS IN CANADIAN WEATHER.

[Reprinted from *Meteorol. Off. Circular*, Nov. 1, 1919, pp. 4-5.]

Previous to the meteorological luncheon at the Bournemouth meeting of the British Association for the Advancement of Science, Sir Frederick Stupart read a paper before Section A, on "Some unsolved problems in Canadian weather," making special reference to the climatic peculiarities of the Province of Alberta. He referred to the pressure and temperature conditions of two recent consecutive Januaries in which the mean temperatures at Calgary were 16° F. and 47° F., respectively. During the cold January the mean pressure of the month in the northwest of Canada was as high as 30.75 inches, but in the mild January only 29.97 inches. In the cold January there was intense terrestrial radiation and light northerly winds prevailed, but in the mild January with the low pressure, föhn (chinook) winds persisted, and the temperature in Alberta was high continuously. The föhn effect was due to the winds from the Pacific having to traverse four mountain chains so that they were dynamically warmed winds. In the discussion that followed Sir Napier Shaw pointed out certain objections that applied to the conventional explanation of föhn effects.

CLIMATE OF THE BELCHER ISLANDS OF HUDSON BAY.

By ROBERT J. FLAHERTY.

[Excerpt from article on "The Belcher Islands of Hudson Bay" in *Geog. Rev.*, June, 1918, vol. 5, pp. 433-458 (pp. 453-454).]

The climate of the islands differs widely from that of the opposite mainland. Compared with weather reports from Great Whale River for the same period, our observations gave a far greater proportion of overcast skies and fogs, stronger and more constant winds, but higher and more equable temperatures. From October [1915] till early December winds of a velocity up to 50 miles were almost constant, and the sky was continuously overcast.

¹ See this REVIEW, p. 163.